Enhancement of the Spectral Emissivity of an Infrared Heater with a Black Metal Compound

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Black metals with K2NiF4 type structure arouse the interest of the scientific community for fifteen years due to their remarkable electronic properties. A common feature describing this family of compounds is based on their black color, which may imply a high spectral emissivity in the domain of the thermal radiative properties. The characterization and the understating of this feature at high temperature remain on a fundamental basis, paradoxically, less known. In this way, we measure the temperature dependence of the optical conductivity of a doped nickelate praseodymium single crystal in the 300-1300 K temperature range. The results obtained from the simulation of the spectra by the Double Dumping Drude plus oscillators model allow estimating the influence of the electron-phonon coupling on the optical absorptions. The polaronic density is sufficient to confer a high spectral emissivity until T=1300 K in a spectral range going from the far infrared to the visible and this for low thickness on this compound. We directly apply this property to enhance the radiative performances of an industrial infrared heater based on an aluminosilicate tile working at T=1000 K. The deposition of a layer of nickelate of praseodymium on such a substrate, greatly improves its low emissivity level in the mid-infrared range. The thermal behavior of the coating tends to the black body one. This spectacular result is not only due to the electron-phonon coupling but also to the rough morphology of the layer. It is constituted by an assembly of spheres of 20-30 micrometers of diameter. The optimized radiators deliver energy in the spectral absorption domains of most of the industrial organic compounds: paints, plastic materials.